

Wind Power Development: *Progress and Challenges*



The State of America's Energy

Sioux Falls, South Dakota

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Overview

- ❖ Wind on the Wires background
- ❖ Status of wind development around the globe
- ❖ Wind development in the Midwest
- ❖ Opportunities and Challenges
- ❖ Summary



About Wind on the Wires

- ❖ **Goal:** overcome barriers to moving wind energy to market – moving from hundreds of megawatts to thousands of megawatts
- ❖ **How:** technical work, regulatory involvement, education and outreach
- ❖ **Scope:** the Upper Midwest – North and South Dakota, Nebraska, Minnesota, Iowa, Wisconsin and Illinois
- ❖ **Board of Directors:** wind developers, environmental organizations, local leaders, technical advisors
- ❖ **Funding:** Energy Foundation, McKnight Foundation, Bush Foundation, Tortuga Foundation, membership dues



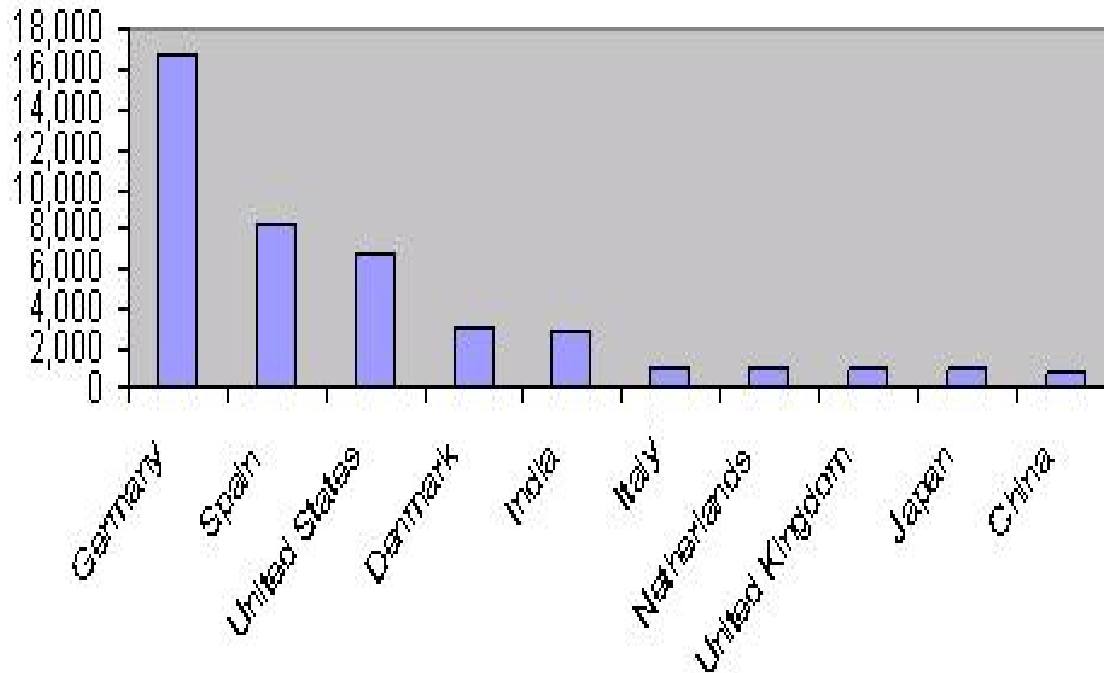
Growth of Wind Energy Capacity Worldwide

- ❖ The global wind industry installed 7,976 megawatts in 2004, an increase of 20%
- ❖ Total global capacity installed = 47,317 megawatts
- ❖ Leading countries in total amount installed:
 - Germany 16,629 MW
 - Spain 8,263 MW
 - United States 6,740 MW
 - Denmark 3,117 MW
 - India 3,000 MW

Source: Global Wind Energy Council (GWEC)



TOP TEN COUNTRIES - TOTAL INSTALLED WIND POWER CAPACITY END 2004 (in MW)

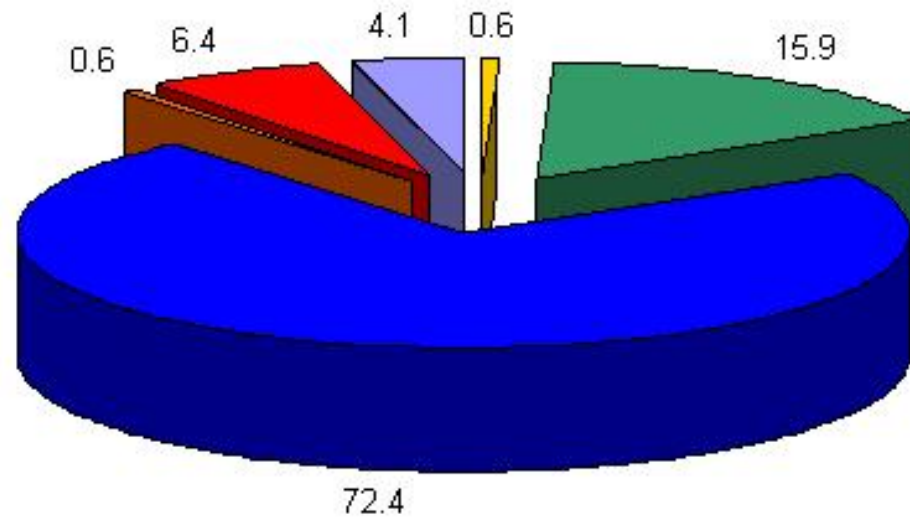


	MW	%
Germany	16,629	35.1
Spain	8,263	17.5
United States	6,740	14.2
Denmark	3,117	6.6
India	3,000	6.3
Italy	1,125	2.4
Netherlands	1,078	2.3
United Kingdom	888	1.9
Japan	874	1.8
China	764	1.6
Top Ten - Total	42,478	89.8
Rest of the World – Total	4,839	10.2
WORLD TOTAL	47,317	100.0

Source: GWEC

Global Distribution

New Installed Wind Power Capacity in 2004



	MW	%
Europe	5,774	72.4
Asia	1,269	15.9
North America	512	6.4
Pacific Region	325	4.1
Latin America + Caribbean	49	0.6
Africa	47	0.6
WORLD TOTAL	7,976	100.0

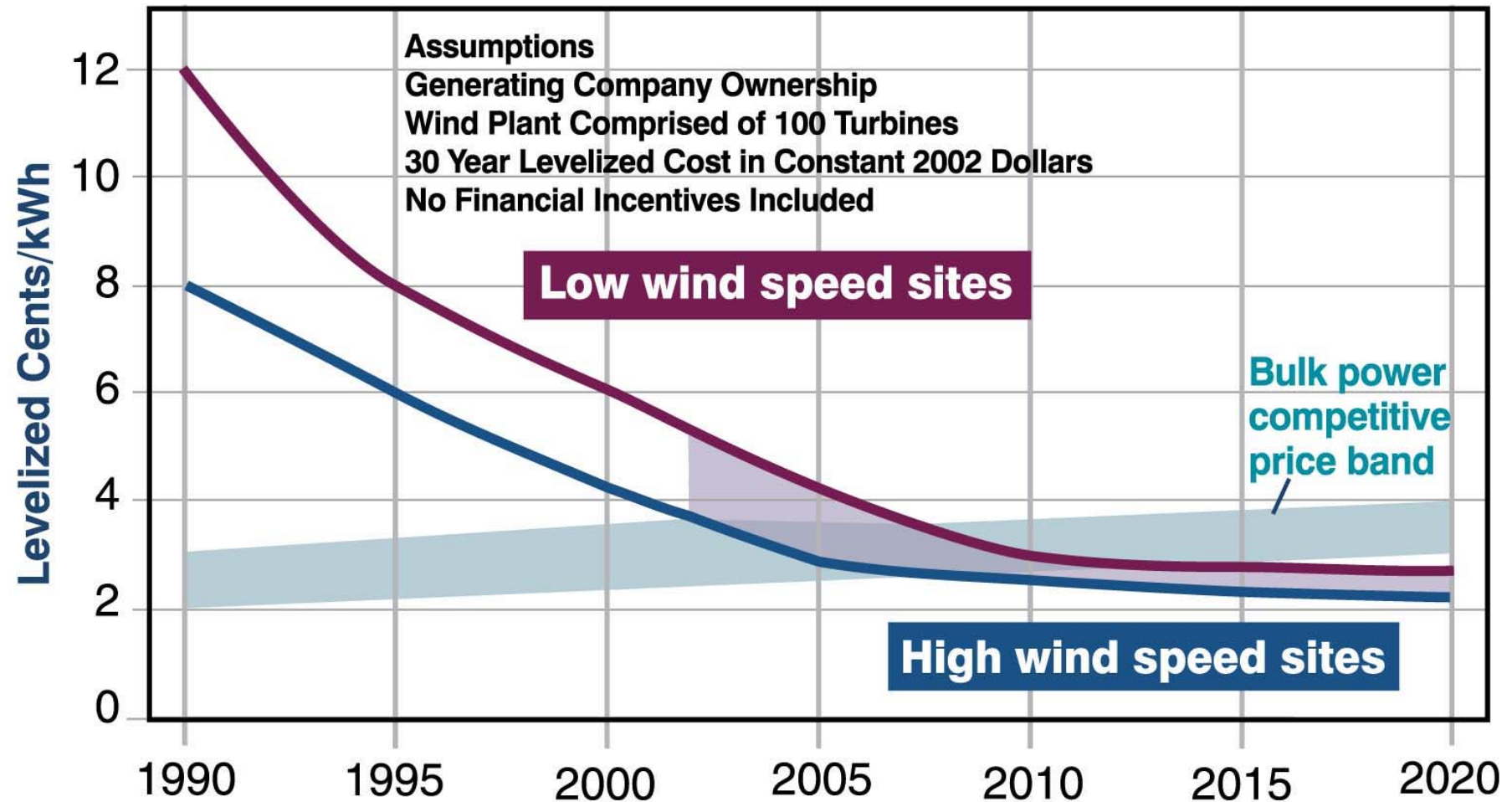
Source: GWEC

United States Wind Power Market Drivers

- ❖ Cost of Wind Energy
- ❖ State Policies
- ❖ High and Volatile Natural Gas Prices
- ❖ Future Federal Policies

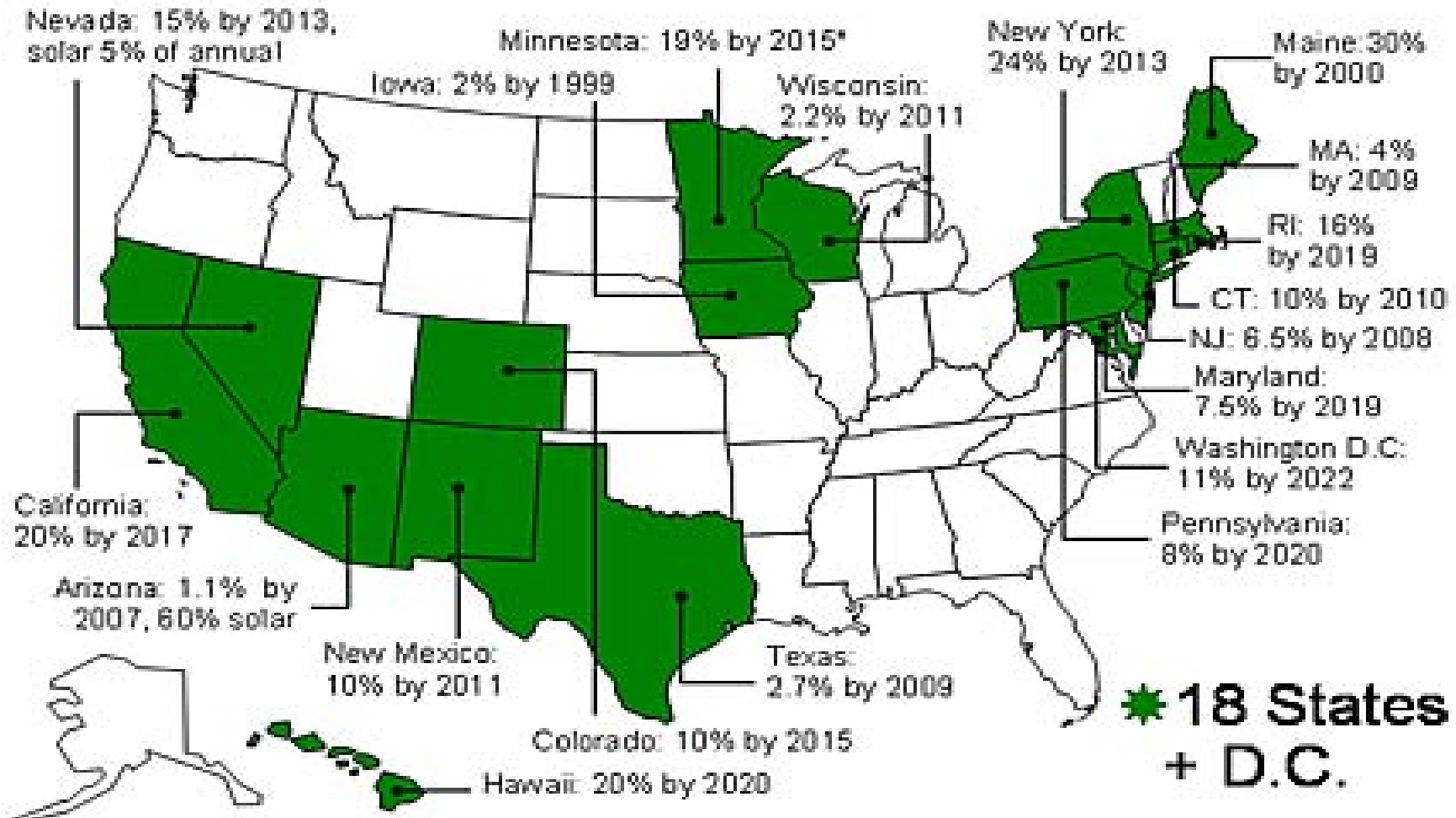


Cost of Wind Energy



Source: DOE/NREL, 2003

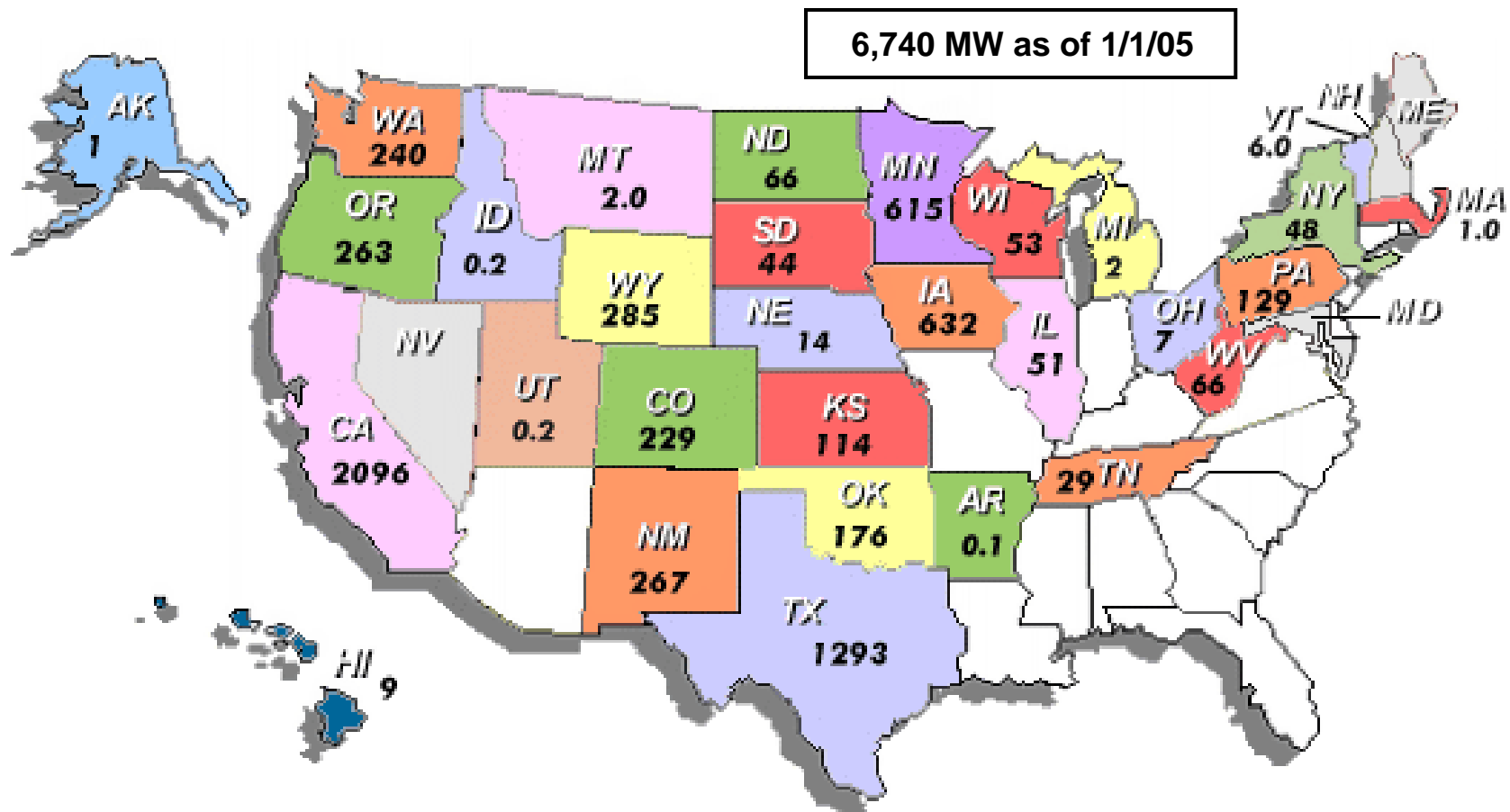
Renewable Electricity Standards



*Includes requirements adopted in 1994 and 2003 for one utility, Xcel Energy.

Source: Union of Concerned Scientists

United States Wind Power Capacity (MW)



2005 U.S. installations projected to exceed 2000 MW

Source: AWEA March, 2005

Midwest Wind Power

	Wind Power, MW			
	Existing ¹	Total Potential ²	% of State Consumption in 2010 ³	
			5%	10%
Illinois	51	6,980	2,668	5,336
Iowa	632	62,900	827	1,654
Minnesota	615	75,000	1,250	2,499
Nebraska	14	99,100	559	1,118
North Dakota	66	138,400	220	440
South Dakota	44	117,200	187	374
Wisconsin	53	6,440	1,363	2,726
Total	1,475	506,020	7,073	14,147

Notes:

1. Nameplate MW, American Wind Energy Association, March 2005, <http://www.awea.org/>
2. Avg MW (approx. 1/3 of nameplate capacity), *An Assessment of Windy Land Area and Wind Energy Potential*, Pacific Northwest Lab, 1991
3. Wind power nameplate capacity; 35% net annual capacity factor and % consumption based on energy and growth from Energy Information Administration, 2001, http://www.eia.doe.gov/cneaf/electricity/st_profiles/profiles.pdf



Key Challenges for Wind Power Development

- ❖ **Lack of transmission capacity** in areas with robust wind resource
- ❖ **Timing mismatch** between rapid wind farm construction and 6-8 year transmission process
- ❖ **Who pays** for new transmission?
- ❖ **Who gets to use the new capacity** on the lines?
- ❖ **Seams issues** between MISO Market Participants and MAPP (both tariff issue and operational issue)
- ❖ **Lack of consensus** on how to **build out** the **transmission** system and related **generation** mix



Proactive Transmission Planning for New Wind Power

- ❖ Rapidly growing markets for new wind power development
- ❖ Wind power is site dependent, rapid construction time, developed in relatively small increments
- ❖ Wind power needs to be included in comprehensive, forward looking, integrated transmission planning



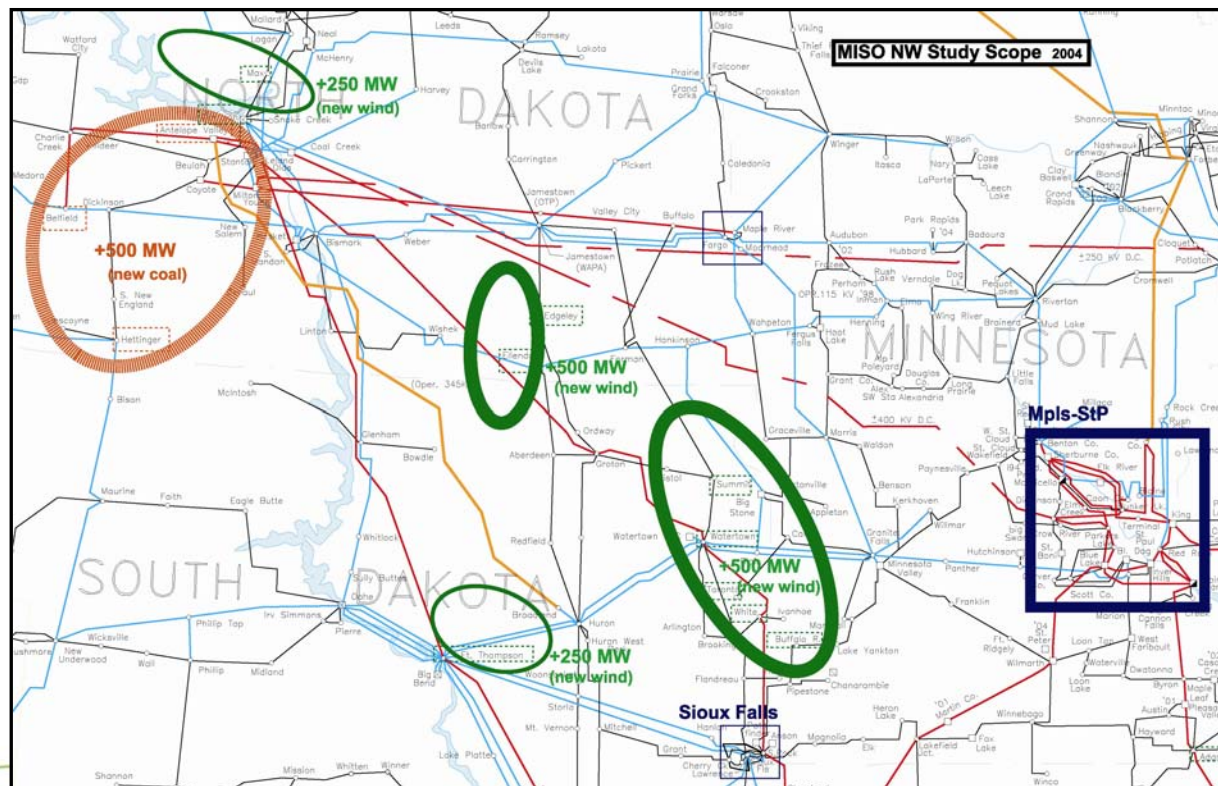
Regional Transmission Studies that include Significant Amounts of New Wind Power

- ❖ CapX 2020 (Xcel Energy, Great River Energy, MN Power, Otter Tail Power, Missouri River Energy Services)
 - Forecast a need for additional 6,000 MW by 2020 to serve load
 - Studying transmission needed for 2,400 MW of new wind (MN REO)
- ❖ MISO Transmission Expansion Plan
 - Northwest Exploratory Study (1,500 MW wind and 500 MW coal)
 - Iowa/Minnesota/Wisconsin Exploratory Study
- ❖ Generation Outlet
 - Buffalo Ridge Incremental Outlet Transmission Study for the next 400-600 MW of wind power (above 825 MW) (Xcel Energy)
 - Resource Coalition (Basin, Minnkota, Heartland, MRES, MDU) studying 600 MW coal, 100 MW wind
- ❖ Western Area Power Administration *Dakotas Wind Transmission Study*
 - Placement of 500 MW of new wind power in North and South Dakota and associated transmission

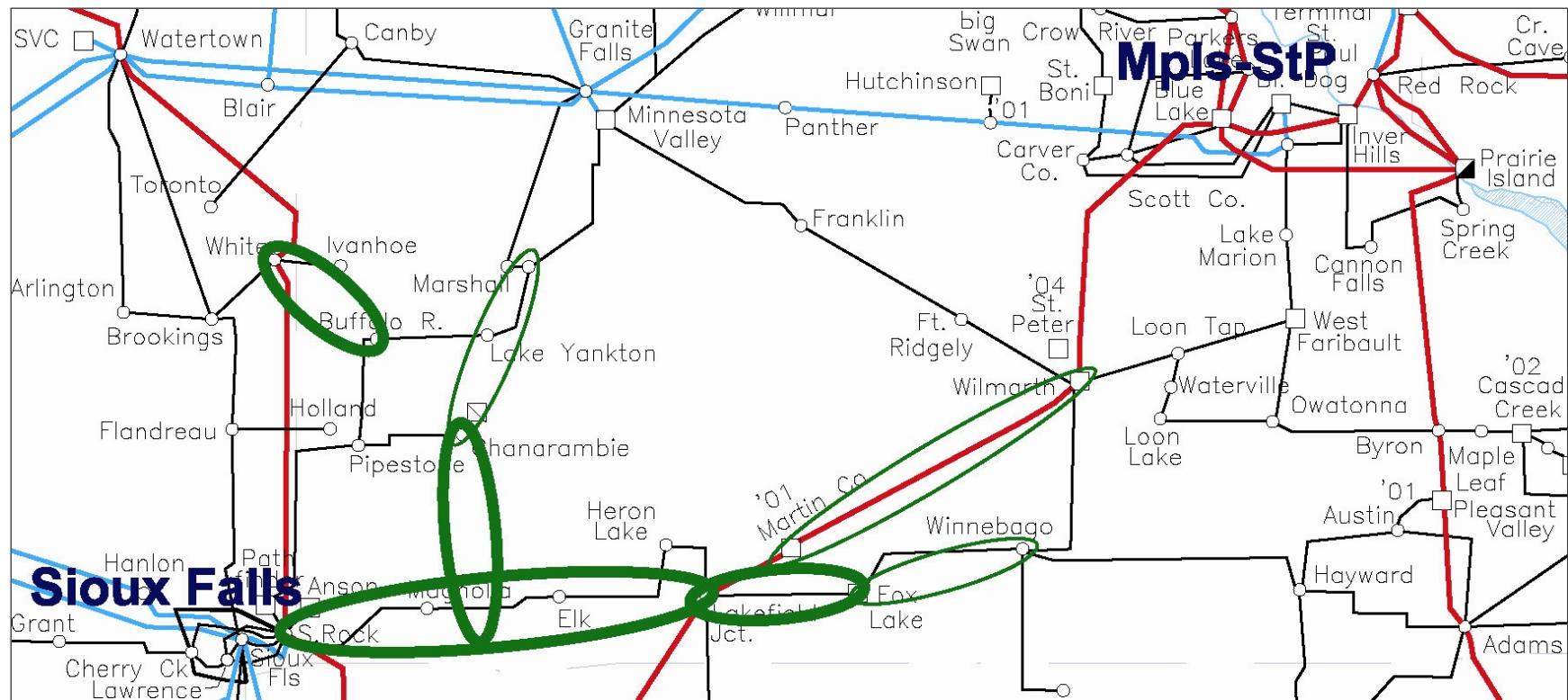


MISO Northwest Exploratory Study

- ❖ Evaluating the incremental transmission delivery capability from potential generation development regions in North Dakota and South East South Dakota that is achieved with various transmission development scenarios.



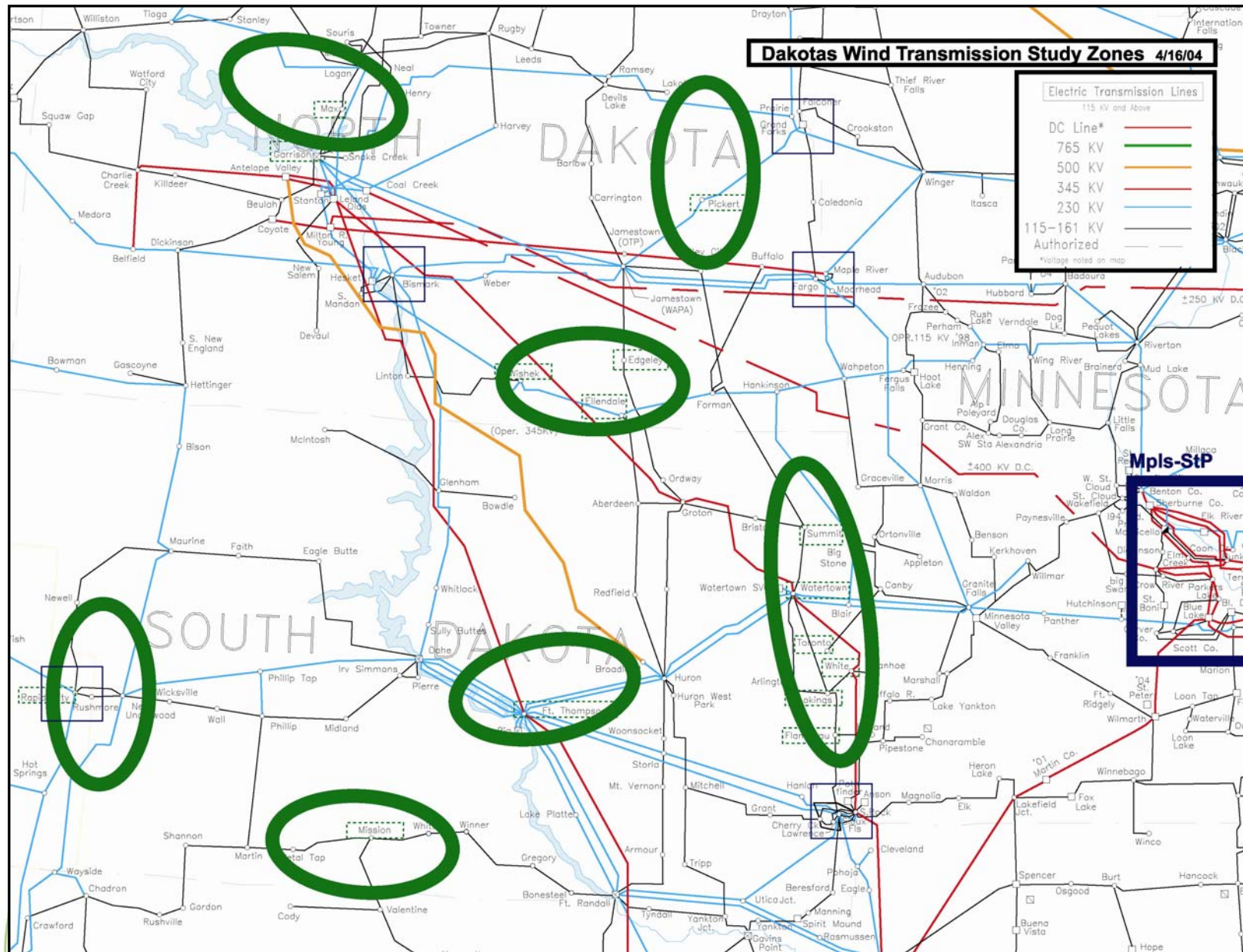
Implementation of New Transmission in SW MN



<u>New lines:</u>	Split Rock – Lakefield Junction*	345 kV
	Lakefield Junction – Fox Lake*	161 kV
	Nobles – Fenton – Chanarambie*	115 kV
	Buffalo Ridge – White*	115 kV
	Chanarambie – Lake Yankton – Lyon	115 kV
<u>Upgraded lines:</u>	Fox Lake – Winnebago	161 kV
	Martin Co – Wilmarth	345 kV

*Xcel Energy Certificate of Need, Minnesota Public Utilities Commission Decision 1/30/03

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Summary

- ❖ Midwest wind power continues to grow rapidly; a robust market is developing in the region.
- ❖ Utilities will increasingly see benefits of adding wind power:
 - Declining cost of wind power
 - Diversifying generation portfolio
 - Hedge against future environmental regulation
 - Profit stream - selling Renewable Energy Credits (RECs)
- ❖ Transmission capacity to deliver wind power is a real issue; planning, approving and constructing transmission is challenging, but it can be done.
- ❖ There will likely be new challenges (e.g., wind integration) as we move to higher wind penetration levels, but technical studies and operating experience will provide innovative solutions.